

of a moderate gale from the north-westward, and much thunder and lightning occurred. Unsettled weather continued from the 21st to the 24th, and from this day a storm area can be clearly traced travelling to the westward. The cyclone reached its greatest violence on June 2 and 3, when the barometer is reported as reading 27.86 inches in close proximity to the centre of the disturbance. A hurricane occurred at Obokh during the evening of the 3rd, and it was reported that all the houses but one had been blown down, and trees had been uprooted. The position of the storm area is not only marked throughout its passage across the Arabian Sea by the cyclonic circulation of the winds, but also by the rain area which accompanied the disturbance; the rate of progress of the storm from May 24 to June 3 was rather less than seven miles an hour.

The second cyclone which is shown by the charts appears to have originated not far distant from Ceylon at the commencement of June, and on the 4th a strong south-westerly gale was blowing on the equator in the longitude of 76° E. This storm can be traced for the next ten days, during which time it passed to the northward and westward towards the entrance of the Persian Gulf. The weather was very disturbed over nearly the whole of the Arabian Sea from the 9th to the 13th, and the area of the storm was much larger than in the case of the Aden cyclone, and gales were experienced from the coast of Africa to that of India, extending over a distance of about 1500 miles. The synchronous weather charts for the last few days of the discussion, after the cyclonic disturbances had passed away, show that the south-west monsoon had extended over the whole of the Arabian Sea, whereas in the middle of May it was limited chiefly to the western side.

Each daily chart contains the observations from several ships in the Red Sea, where the wind direction and other elements of the weather are very instructive. The southerly march of the northerly or north-westerly wind, which throughout the whole period prevails over the northern portion of the Sea, and the gradual backing down of the southerly winds in the southern portion of the Sea are well shown. The northerly wind in the northern portion of the Red Sea often attains the force of a gale, but there is no instance in the charts of the southerly winds attaining gale force. The air temperature is generally higher in the Red Sea than over the more open water in the Arabian Sea, the reading of the thermometer commonly reaching 90°, and on June 14 the temperature at 10 o'clock in the morning was 102° over the open sea, nearly abreast of Musawwā. The charts show many other points of interest, among these the flow of the current under the influence of disturbed weather as well as when the sea is comparatively quiet, and doubtless the volume will throw some additional light on the winds and weather in this part of the world, where at present the meteorological changes are not too well understood.

ON VAN DER WAALS'S ISOTHERMAL EQUATION.

IN reply to Prof. Tait's criticism (NATURE, December 31, 1891, p. 199) of my paper (December 17, p. 152), I wish to say that I certainly do not consider Van der Waals's b as an absolute constant. Perhaps it may be interesting to show how the limits of its variability can be determined.

Leaving aside the question of the attractive forces, which probably has been sufficiently elucidated in the course of this discussion in the columns of NATURE, and considering gases as aggregations of elastic spheres, then in the formula—

$$p_1(v - xb_1) = \frac{1}{3} \Sigma mu^2 \dots \dots \dots (1)$$

x can be proved to be equal to 4 for large volumes and small pressures.

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Again, in the case of *extremely large* pressures, when the volume is nearly reduced to the smallest possible dimensions, it is easy to see that a formula—

$$p_1(v - \mu b_1) = \frac{1}{3} \lambda \cdot \Sigma mu^2 \dots \dots \dots (2)$$

must hold good, where $\mu b_1 = 3\sqrt{2}/\pi \cdot b_1 = 1.35 \dots b_1$ represents the space in which the spherical molecules can be inclosed when they are motionless, and λ is a certain numerical coefficient whose determination might present some interest, and perhaps is not beyond the scope of mathematical analysis. (For one-dimensional motion $\lambda = 1$.) Be this as it may, putting (2) in the form—

$$p_1 \left[v - \left(1 + \frac{\lambda - 1}{\lambda} \cdot \frac{v - \mu b_1}{\mu b_1} \right) \cdot \mu b_1 \right] = \frac{1}{3} \Sigma mu^2, \dots \dots (3)$$

it is clear that in *this* case x approaches the value $\mu = 1.35$.

Now surely, for *intermediate* volumes and pressures, xb_1 cannot be considered as a constant; still, along the large range of these pressures, the correction required must be called *relatively* slight, and the more so as it is beyond doubt that a considerable part of the change from 4 to 1.35 takes place near those extreme pressures where, according to (3), x may be very variable. Whether at the critical volume this coefficient has undergone already a practically important change from its original value, 4, seems to me a question which cannot easily be answered by purely theoretical considerations.

In my opinion, in all cases except in that of large volumes the formula (1) is preferable to a formula

$$p_1 v = \frac{1}{3} \left(1 + \frac{4b_1}{v} + \frac{\sigma b_1^2}{v^2} \right) \cdot \Sigma mu^2, \dots \dots (4)$$

even if the numerical value of σ could be exactly calculated; therefore the question at issue does not simply turn on the introduction or rejection of terms of the order β^2/v^2 , and it was looking at the matter from this point of view that in my paper I once called a formula of the form (1) the *true* one as distinguished from a formula of the form (4), and not from any formula given by Prof. Tait. Certainly, none of the isothermal equations given by different authors can be named *true* in the sense of representing with absolute exactness the conduct of real gases; and of course, when more constants are introduced in these equations than are contained in that of Van der Waals, a better approximation to the conduct of these gases may be reached.

In conclusion, I beg to add a few words about Prof. Tait's third remark. It seems to me that he has no right to identify the process of putting arbitrarily $\gamma = \beta$ with that of calculating the correction indicated by Prof. Lorentz.

D. I. KORTEWEG.

Amsterdam, January 6.

NOTES.

SEVERAL scientific meetings have been postponed in consequence of the death of the Duke of Clarence. Prof. W. E. Ayrton, F.R.S., was to have delivered his inaugural address, as President of the Institution of Electrical Engineers, on January 14. It will be delivered at a meeting of the Institution on January 28. The annual general meeting of the Royal Meteorological Society, fixed for the 20th, will be held on the 27th, when the President, Mr. Baldwin Latham, will deliver an address on "Evaporation and Condensation." The annual meeting of the Entomological Society is also adjourned from the 20th to the 27th.

THE forty-fifth annual general meeting of the Institution of Mechanical Engineers will be held on Thursday and Friday evenings, February 4 and 5, at 25 Great George Street, West-

minster. The chair will be taken at half-past seven p.m. on each evening. The President, Mr. Joseph Tomlinson, will retire, and will be succeeded by the President-elect, Dr. William Anderson. The following papers will be read and discussed, as far as time permits:—Notes on mechanical features of the Liverpool water-works, and on the supply of power by pressure from the public mains, and by other means, by Mr. Joseph Parry, water engineer, Liverpool (Thursday). On the disposal and utilization of blast-furnace slag, by Mr. William Hawdon, of Middlesborough; communicated through Mr. Charles Cochrane, past-President (Friday).

THE German Mathematical Association (Deutsche Mathematiker-Vereinigung) propose to hold their annual meeting in the autumn of this year at Nuremberg, and at the same time an Exhibition of Mathematical and Physical Models and Apparatus is to be brought together under the auspices of the Government. This Exhibition will resemble that of the Loan Collection, held at the South Kensington Museum in 1876. At Nuremberg the corresponding Germanisches Museum is available for the same purpose. The German Mathematical Association request the concurrence and assistance of those persons and institutes interested in the subject in this country, so as to make the Exhibition as complete and representative as possible.

THE American Institute of Electrical Engineers has passed a resolution declaring its intention to co-operate with "the World's Congress Auxiliary" in the effort to secure the gathering of an International Electrical Congress at Chicago in 1893, and pledging itself to do everything in its power to make the Congress a successful and worthy representation of the best electrical science and practice in all parts of the world. According to a prospectus issued by the World's Congress Auxiliary, the Congress will deal with "scientific and technical electricity, telegraphy, telephony, electric light, electric power, and other forms of electrical application, with appropriate chapters and sections for the proper consideration of each."

THE friends of Prof. Baird, the late Secretary of the Smithsonian Institution, will regret to hear that his widow, Mrs. Spencer F. Baird, died at her home in Washington on December 23, 1891.

M. DE QUATREFAGES, the well-known anthropologist, died on Tuesday, January 12. He was born in 1810, and studied medicine at Strasburg. Afterwards he became Professor of Zoology at Toulouse, where he had settled as a medical practitioner. In 1855 he was made Professor of Anthropology and Ethnology at the Jardin des Plantes, Paris. He had already been admitted to the Academy of Sciences in 1852, and he was an honorary member of many foreign learned Societies. Numerous friends and pupils were present at his funeral, and addresses were delivered by M. Milne-Edwards, and other men of science. The most famous of his writings are his "Crania Ethnica" and "Études des Races Humaines."

MR. W. L. SCLATER, Deputy-Superintendent of the Indian Museum, Calcutta, has been appointed Curator of the Museum and Lecturer on Biology at Eton College.

IN a letter on "A Difficulty in Weismannism," published in NATURE on December 3, 1891 (p. 103), Prof. Hartog quoted some passages from a private letter he had received from Prof. Weismann. To this letter reference was made in a subsequent communication by Mr. A. H. Trow (p. 175). Prof. Hartog has sent us Prof. Weismann's letter, but we do not consider it necessary to print it, as the correspondence is now closed.

AN important and interesting paper on Chinese fibres appears in the new number of the *Kew Bulletin*. It seems that at Chinese ports there is much confusion as to the origin and classification of

these fibres, different fibres sometimes bearing the same name, while the same product often bears different names at different ports. This confusion is apparently due in part to the fact that European traders have used the terms "jute" and "hemp" in a generic rather than a specific sense; in part to the fact that the duty on "jute" is only "2 mace per picul," whereas "hemp" pay 3½ mace. The subject has lately been carefully investigated at Kew, and further inquiry is about to be made at the Chinese ports under the direction of Sir Robert Hart, Inspector-General of the Chinese Imperial maritime Customs. At Kew much help has been derived from specimens sent by the Acting Consul at Chefoo, Mr. Alexander Hosie, a report by whom is included in the paper in the *Bulletin*. A memorandum on the jute and hemp of China, by Dr. Augustine Henry, is also given. The question is one of considerable practical importance, as the confusion which prevails cannot but tend to hinder the development of trade.

ANOTHER interesting paper in the *Kew Bulletin* is on Ipoh poison of the Malay peninsula. It consists chiefly of a valuable report by Mr. Leonard Wray, Junior, Curator of the Perak Government Museum, who has sent to Kew an admirable series of specimens. The report is printed in advance of the results of the examination of the presumed poisonous fluids, which has again been undertaken by Dr. Sidney Ringer, F.R.S., Professor of Clinical Medicine, University College, London.

DR. BROWN LESTER, who accompanied the Gambia Delimitation Commission, made a botanical collection fairly representative of the flora in the neighbourhood of the River Gambia, as far as the dryness of the season would permit. The specimens have been determined at Kew; and a list of the determinations, with Dr. Brown Lester's brief notes, is given in the *Kew Bulletin*. From a botanical point of view, the collection, according to the *Bulletin*, is not of very great interest; but it is said to afford a useful picture of the character and productions of the country traversed.

IN an appendix to the latest number of the *Kew Bulletin*, a list is given of the staffs of the Royal Gardens, Kew, and of botanical departments and establishments at home, in India, and in the colonies, in correspondence with Kew. On two former occasions a list of the same kind has been issued in the *Kew Bulletin*; and it has been found of considerable value, as it affords a convenient means for placing on record the official titles and designations of the officers concerned, and renders possible the notification of the changes that take place in the several appointments. The new list includes an enumeration of the officers that have been selected to carry out the recently-organized botanical survey of India, with the districts allotted to each one. There is also a fuller list of officers in charge of gardens in Native States. The organization of the botanical department of the Leeward Islands brings into one group the several botanical stations existing in those islands.

MM. LABORDE AND RONDEAU have given, in the *Revue Mensuelle d'Anthropologie*, an account of recent experiments on the poison of the arrows of the Sarro savages, in the Upper Niger valley. Specimens were brought back by Lieutenant Jaime. From the physiological experiments performed, it would seem that the poison is identical with that of *Strophanthus*.

SEÑOR F. P. MORENO, who has been investigating some ancient graves in the Argentine Province, Catamarca, has found various objects which are likely to be of considerable importance in the study of American archæology. He has secured 86 human skulls, 400 vases, 420 stone implements, 15 copper implements, and 110 objects made of bone. The skulls are of two different types, one set resembling those found in the graves at Ancon, Peru,

another those of Indians in Chaco and in the south of the Argentine Republic. All are brachycephalic, and many have been artificially distorted. The skulls of the Peruvian type are the later of the two groups. It is evident, however, that before the appearance of the Peruvian element, in what is now Catamarca the population were in a much higher position than the Indians of the present day. They built strong fortresses, like those which are found in Arizona and New Mexico, and the traces of their dwellings indicate a comparatively advanced stage of civilization. Many of the remains remind Señor Moreno of the Mexicans, others seem to show some affinity between the people and the Chibcha, while others are of a quite peculiar character. He has given a provisional account of his results in the *Revista de la Plata*, 1890-91.

MR. JAMES F. HOBART contributes to the January number of the *Engineering Magazine*, New York, an interesting article on the paper-making industry. He notes that while in 1881 the United States produced only 5,315,400 pounds of paper, it produced in 1891 not less than 15,219,580 pounds. Even this rate of production is exceeded by Germany. Mr. Hobart, however, thinks there are indications that the United States will lead the world in the production of paper before the end of the century.

THE new number of the *Board of Trade Journal* contains some extracts from a valuable report by the French Agent at Victoria on the salmon industry in British Columbia. Among the details noted by him is the fact that the best fish are almost always taken on the outflow of the river in the place where the fishermen endeavour to meet the fish on their arrival from the sea. A boat is often filled with several hundred fish in a single drift net of from 400 to 500 metres. It is calculated that on certain days the total of the Fraser fishery amounts to not less than 150,000-salmon, which are passed through all the different phases of preserving, and are ready to be forwarded for the market on the same day. An ingenious apparatus used to take the salmon, chiefly on the Columbia River in the United States, is described. A large wheel, fixed at a certain distance from the bank, is put in motion by the current. The blades of this wheel are provided with a network of iron wire intended to raise from the water any large object coming in contact with them. A sort of bar-work starting from the wheel is so placed as to increase the strength of the current in such a manner as to force the fish passing on this side of the river to go in this direction. The salmon, wishing to cross the very rapid stream where the wheel is placed, is raised out of the water by the iron wire on the blades. In the rotary movement the salmon is carried to the centre of the wheel, whence an inclined plane conducts it into vast open reservoirs placed in the stream, where it can be kept alive for some time. A system of pulleys provides for the raising of these reservoirs, the water flows out, and the salmon is carried in boat-loads just as it is required for preparation.

THE U.S. Consul at Bordeaux gives, in a recent report, some interesting information about the wines of the Medoc district. He notes that this district, between the sea on the one hand and the Garonne and Gironde Rivers on the others, is called Medoc (*quasi medio aquæ*), because nearly surrounded by water. It is the northern termination of the extensive tract of sand-hills and marsh-land called "Les Landes," extending from Bayonne north, which changes to a bank of gravel on approaching the left bank of the Garonne, and contains some of the most precious vineyards in the world. The soil is of light pebble, and, indeed, on the spots where some of the best wine is produced it appears a mere heap of quartz mixed with the most sterile quality of earth. The best wine is not produced where the bush is most luxuriant, but on the thinner soils, where it is actually stunted, and where weeds disdain often to grow. Here the vine retains the sun's heat about its roots after sunset, so that its

juices are matured as much by night as by day. The accumulation of sand and pebbles of which this soil is composed is apparently the spoils of the Pyrenean rocks, brought down by the torrents tributary to the Garonne and other great rivers, and deposited in former ages on the borders of the sea. At a depth of 2 or 3 feet from the surface occurs a bed of indurated conglomerate, which requires to be broken up before the vine will grow.

THE latest publication issued by the Meteorological Council contains the harmonic analysis of hourly observations of air temperature and pressure at British Observatories. The computations as originally undertaken were designed to supply the analysis of the hourly observations made at Greenwich Observatory which were published in 1878; but subsequently it was determined to extend the investigation so as to include the observations made at the seven Observatories maintained by the Meteorological Office for a series of twelve years. The onerous work of calculation has been considerably diminished by means of the mechanical analyzer designed by Sir William Thomson, and by special formulæ, tables, and a slide rule prepared by General R. Strachey, Chairman of the Council. A drawing of the scale, and an explanation of its application, are given in the preface to the work.

THE Meteorological Council have just issued a useful publication entitled "Ten Years' Sunshine in the British Isles, 1881-90." The observations have been taken at forty-six stations, well distributed over the country—except for Scotland and Wales. At the great majority of stations the instrument used is the Campbell-Stokes sunshine-recorder, which focusses the sun's rays, by means of a glass ball, on to a card fixed in a brass frame. The instrument records only bright sunshine, which burns the card when no mist is present, or no cirrus or other clouds obstruct the rays. The tables show that December is the most sunless month of the year. Jersey stands first on the list of stations, as it does in nearly all other months of the year, having 23 per cent. of possible duration, while Dublin has 21 per cent., and St. Ann's Head 20 per cent., and London has a miserable record of 2 per cent. A great increase is noticeable in February, when Jersey has the greatest amount, viz. 31 per cent., and London the least, 9 per cent. In April, London begins to compare more favourably with other places situated in the suburbs, and May is the sunniest month of the year, while June and July are by no means as sunny as might be expected. August is a good month, except in the north-west of Ireland and Scotland. September and October exhibit a considerable decrease, and November is the only month in which the Channel Islands are not the most sunny part of the British Isles. The sea-coast generally is more sunny than inland parts, while large manufacturing cities, such as Glasgow, compare badly with stations in their neighbourhood. In the late autumn, Ireland generally receives more sunshine than the most of England.

It is useful, in relation to meteorology, to note the date of commencement of various harvest operations. A French Abbé, M. Buvé, has recently suggested a consideration of the quantity of sugar produced in certain plants as a means of determining the meteorological elements concerned in this process. The physiology of the sugar beet is now pretty well known; and, according to M. Marié Davy, one may estimate pretty closely the yield of this plant by means of calculations from the heat and illumination to which it has been subject. Conversely, the Abbe points out, we might determine the heat and light received, through the quantity of sugar produced. Fiscal operations, determining the yield of sugar, would facilitate the process. Again, it is suggested that the yield of honey might be considered in the same relation—the quantity of it in flowers depending greatly on sunshine, wind, rain, &c., while the state of the

atmosphere favours or hinders the work of bees. The summers of 1889 and 1890 are cited as presenting a marked contrast with regard to both beet-sugar and honey, in correspondence with weather-conditions; the earlier year was a highly prosperous one, the latter quite the opposite.

IN the Report, just issued, of the U.S. Commission of Fish and Fisheries, on the fisheries of the great American lakes in 1885, it is noted that in Lake Michigan there is no fishing through the ice in the southern end of the lake, but that in the northern end, especially in Green Bay and along the north shore, this fishery is extensive. For twenty years it has given employment to a very large number of men living in the neighbourhood of Green Bay, and many fishermen from other localities have found work there during the winter months. During the winter season the bay used to present greater activity than the surrounding land, hundreds of shanties and temporary huts being built for shelter. Dealers drove about from place to place on the ice to purchase the catch, and merchants sent waggons with provisions for the fishermen. At the height of the season it was not uncommon for the fishermen to bring their families out to the fishing quarters, where they would remain for some weeks, all hands helping to keep the nets in repair. For several years this fishery, owing to the diminished quantity of white-fish, has been less extensive, and the fishermen engaged in it at present generally live at home, owning a horse and sleigh, which enable them to visit their nets daily.

AT a recent meeting of the Field Naturalists' Club of Victoria, Baron von Mueller advocated strongly the protection of insectivorous and native birds in the colony. He thought that this object might be attained, not only by putting a comparatively heavy tax upon guns and by more strictly enforcing the present laws, but by the initiation of some scheme which would enlist the sympathy and co-operation of all persons interested in the subject. He suggested that a distinctive badge might be worn by members if such a union were ever formed.

THE Académie Royale des Sciences, des Lettres, et des Beaux Arts de Belgique has issued its *Annuaire* for 1892. It contains, besides much information as to the organization and activity of the Academy, biographical sketches of deceased members, with remarkably good portraits.

AN interesting memoir is contributed by Dr. Merz, of Zurich, to the current number of the *Berichte*, concerning the compound of nitrogen and magnesium, generally known as magnesium nitride, Mg_3N_2 . Magnesium, like boron, appears to possess a somewhat powerful affinity for nitrogen. Some years ago Deville and Caron, during their distillations of magnesium for the purpose of obtaining the pure metal, observed the presence of small transparent crystals, containing only magnesium and nitrogen, upon the surface of the distilled metal. More recently, Briegleb and Geuther have shown that nitride of magnesium in an amorphous form may be prepared by heating magnesium filings in a porcelain boat placed within a porcelain tube traversed by a stream of nitrogen. Dr. Merz now describes two extremely simple methods of obtaining the nitride, suitable for lecture demonstration, and also some further properties of this interesting substance. A quantity of finely-powdered and carefully dried magnesium, about two grams in weight, is placed in a wide piece of combustion tubing about twenty centimetres long, closed at one end. Attached to the open end of this tube by means of a wide caoutchouc connection is a narrower tube closed by a caoutchouc stopper, through which passes the nitrogen delivery tube. A short side-tube blown upon the narrower tube carrying the stopper serves for the exit of the gas, and is connected by narrow caoutchouc tubing with a long vertical tube bent round parallel to itself, the open end of which dips beneath

the surface of some coloured water. The air is first displaced from the whole apparatus by means of pure dry nitrogen, and when this is accomplished, the combustion tube containing the magnesium, laid nearly horizontally, is heated by means of a triple Bunsen burner. After two or three minutes have elapsed from the attainment of a red heat, the speed of the current of nitrogen may be slackened by means of a screw clip placed somewhere in its path, when the coloured water will rapidly rise in the vertical tube, attaining a height of ten feet, if the tube is so long, in a couple of minutes, thus exhibiting in a graphic manner the rapid absorption of the nitrogen by the magnesium. On allowing the experiment to proceed for upwards of an hour, almost the whole of the magnesium is converted to nitride, the small remainder reacting with the glass, and producing a black mirror of silicon. Magnesium nitride obtained by this method is a light, voluminous, friable, and yellowish-gray-coloured substance when cold, but reddish-brown while hot. When exposed to the air, it smells strongly of ammonia, owing to its decomposition by the moisture present. When a little water is poured upon it, great rise of temperature occurs, together with hissing, increase in volume, and evolution of steam, just as when quicklime is slaked. Ammonia is also evolved in large quantities, and white magnesium hydrate remains. The decomposition by means of water is most effective when performed at the bottom of a large flask, which rapidly becomes filled with ammonia gas; the moment a little hydrochloric acid is introduced upon a feather or other convenient carrier, the flask becomes filled with dense fumes of ammonium chloride. Dr. Merz further shows that the nitride may likewise be obtained by heating magnesium in a current of dry ammonia to a temperature considerably lower than that which is required in the case of free nitrogen, and very much lower than that employed by Briegleb and Geuther in some similar experiments made by them. As soon as this temperature is attained, a brilliant incandescence occurs, and the flame may be removed; hydrogen is evolved in a rapid stream, and 95 per cent. of the magnesium is converted in three or four minutes to nitride.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus* ♂), a Sooty Mangabey (*Cercocebus fuliginosus* ♀) from West Africa, presented by Canon Taylor Smith; a Moustache Monkey (*Cercopithecus cephus* ♂) from West Africa, presented by Mr. Alfred Lloyd; a Silver-backed Fox (*Canis chama*) from Damaraland, South Africa, presented by Mr. E. Aubrey Hart; two Virginian Opossums (*Didelphys virginiana*) from North America, presented by Mr. John Brinsmead, F.Z.S.; a Common Jay (*Garrulus glandarius*), British, presented by Mr. Charles Faulkner; a Great Titmouse (*Parus major*), a Coal Titmouse (*Parus ater*), a Blue Titmouse (*Parus caeruleus*), British, presented by Captain Salvin; a Bonham's Partridge (*Ammoperdix bonhami*) from Western Asia, deposited; a Bronze-winged Pigeon (*Phaps chalcoptera* ♀) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

MOTION OF STARS IN THE LINE OF SIGHT.—Prof. H. C. Vogel, in *Monthly Notices R.A.S.* for December 1891, fully describes the method used at Potsdam for determining the velocity of stars in the line of sight, and states the chief results that have been obtained since the work was begun in 1887. In order to insure great stability with the smallest possible weight, the frame of the spectroscope is made of cast steel. The camera is also constructed of steel, and the dark slides are of brass. It may be worth remarking, however, in this connection, that stability would have been secured if aluminium had been used instead of steel and brass, and this with a little more than one-third the weight. A spectroscope similar to Prof. Vogel's, but